Proposal 2015-2016

Topic #4 - Improvement of the aerodynamic behavior of a blended wing body UAV: numerical and experimental investigations

Contacts

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Context

The company Aircraft Traders s.a. is developing an Unmanned Aerial Vehicle (UAV) dedicated to the long distance supervision of ground activities: GuardianEye. This UAV is characterized by a blended wing body geometry (span of 2.2m), including winglets and a propeller located at the back of the aircraft.

The first prototype of the UAV (GE1) is operational and used by the company to perform preliminary flight tests. Another prototype (GE2), 50% larger than the previous one, is currently under development. In parallel of these first prototypes, it is desirable to improve the global performances of the aircraft by a detailed analysis of its aerodynamics. The improved geometry will be named GE+.

A wind tunnel test campaign was carried out on GE1 at the Wind Tunnel Laboratory of ULg in December 2014. This set of experimental data will be the starting point of the project and be used as a validation test case for the numerical analyses. Once validated, the numerical models will be used in to carry out a sensitivity analysis of the main geometric parameters on the aerodynamic efficiency of the UAV. At the end of the project, a scaled model of the improved geometry (GE+mini) will be built and tested in the wind tunnel in order to validate the proposed geometric modifications.

Objectives

The objective of this final year project is to develop an numerical/experimental framework that leads to the improvement of the capabilities of the GuardianEye: flyability and performances. The activities are shared between numerical analyses and experimental investigations at the WTL of ULg.

The bulk of the work will be carried out at the company site and at the wind tunnel laboratory of University of Liège.

The TFE will consist in:

- Literature survey about blended wing body aerodynamics.
- Modelling GE1 using the software PAN-AIR*. PAN-AIR is a 3D panel code developed by NASA in the 80's. It is well suited for preliminary aerodynamic design.
- Validation of the PAN-AIR model with existing wind tunnel measurements.
- Development of a CFD model of the GE1 geometry using the software SU2†.
- Comparison with the PAN-AIR results and wind tunnel measurements (GE1)
- Sensitivity analysis of the main geometric parameters (airfoil profile, wing span, winglets dimensions, dihedral and sweep angles, ...) on the lift to drag ratio, leading to an improved geometry (GE+).
- Sensitivity analysis of the Reynolds number (GE+ - GE+mini).
- Validation of the improved geometry by new wind tunnel measurements (GE+mini)

Profile

The student must have some familiarity with fluid mechanics and flight mechanics and be highly motivated. Following courses are recommended:

- APRI0004-1 - Aerospace design project
- AERO0032 - Aeroelasticity and Experimental Aerodynamics
- AERO0030-1 - Computational Fluid Dynamics

* http://www.pdas.com/panair.html

† http://su2.stanford.edu